Utility MACT Working Group

Utility MACT data acquisition and analyses

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Purpose

- To provide background on how the data were gathered
- To provide information on the adequacy of the data

Information we sought

- Facilities (Part 1)
- Fuel analyses (Part 2)
- Speciated mercury emission results (Part 3)

Background -- Identification of units (Part 1)

- Units identified through
  - Existing Utility Data Institute (UDI) Power Statistics Database
  - EPA/Office of Air Programs (OAP) database of non-utility generators
- Each “suspected” coal-fired unit sent section 114 letter in November 1998 requiring
  - Fuel used
  - Boiler type
  - Controls

Background -- Coal analyses (Part 2)

- Coal-fired units required to analyze coal for mercury, chlorine, ash, sulfur, Btu, moisture
  - Every sixth shipment, minimum of three per month
  - Frequency could increase or decrease based on statistical analysis of the results of previous quarter's data
  - Analysis method not mandated by EPA
  - NIST analyses required for QA/QC
- Also required to report fuel usage data submitted to DOE/EIA

Background -- Stack testing (Part 3)

- All coal-fired units categorized based on
  - SO_2 control (wet scrub, dry scrub, no scrub)
  - Fuel type (bituminous, subbituminous, lignite)
  - PM control (cold-side ESP, hot-side ESP, other)
  - Also categories for FBC and coal gasification
  - Resulted in 36 populated categories

Background -- Stack testing (Part 3, conc.)

- Categories NOT based on
  - Age of unit
  - Size of unit
  - NO_x control
  - Stack temperature
  - Duct length
  - Geographic location
  - Boiler type
  - Anything else

Background -- How tested plants were selected (Part 3)

- Units in each category alphabetized by plant name
- Where there were more than three units in a category, units were randomly selected for speciated mercury emissions testing using Ontario-Hydro method
- DOE-tested units allowed to substitute if testing done by Ontario-Hydro method, or equivalent

Background -- How tested plants were selected (Part 3, conc.)

- Five units excluded from testing
  - Co-owned with identical unit
  - Not likely to operate or not operational
  - Involved in litigation
- One unit substituted for excluded unit
- Six units voluntarily tested by company
- One unit tested twice

Background -- Stack test QA/QC

- Copies of Ontario-Hydro method provided to utilities
- Utilities required to provide QAPP for EPA review and approval
- EPA audited four stack tests
- EPA reviewed all test reports
  - Data extracted
  - Reports QA/QC'd
  - Follow-up with plants on questions

What we found

- Facilities
- Fuel analyses
- Speciated mercury emission results

Facilities -- How many?

- Identified 1,143 coal-fired utility boilers
  - Located at 461 facilities
  - Located in 47 of the 50 States
    - No units identified for ID, RI, or VT

Fuel analyses -- How many?

- What we received (40,527 total analyses)

Anthracite-only analyses	**65**
Bituminous-only analyses	**27,793**
Lignite-only analyses	**1,047**
Subbituminous-only analyses	**8,180**
Waste anthracite analyses	**426**
Waste bituminous analyses	**572**
Waste subbituminous analyses	**53**
Tire-derived fuel analyses	**149**
Petroleum coke analyses	**1,150**
Mixture analyses	**1,092**

Fuel analyses -- How good?

- Nothing to indicate that the fuel analyses are not as accurate as possible
- Nothing to indicate that the fuel analyses are not representative of the major solid fuels being burned in “coal-fired” units

Fuel analyses -- Conclusion

- Fuel analyses data are sufficient to use in the development of MACT standards

Stack test data -- How many?

- 86 speciated mercury emissions tests
  - 7 tests from DOE test program
  - 6 volunteered tests
  - 73 tests under authority of section 114 (including one unit tested twice)

Required data

- Measurements before and after last control device
  - Speciated mercury + normal emission test parameters (flow rates, temperatures, O_2, H_2O, etc.)
  - Coal properties (mercury content, chlorine)
- Uniform format for all tests

Required data (conc.)

- What we did NOT require
  - Mercury in ash samples
  - LOI in ash
  - Other elemental constituents in ash or coal (e.g., Fe, Al, Ca, Na)
  - Anything else

Data obtained

- Valid tests from 80 units for use in national model
- Most boiler, fuel, control types tested
- 6 tests “eliminated” from national model due to incomplete data
  - Not necessarily “bad” data
  - Couldn’t be used in our analysis format so not used in national emission model
  - May be used in other analyses

Stack test data – Reason for rejection from national model

- 6 tests excluded from national model as follows
  - Coal Creek: no flow rates or O_2 values before last control; missing some coal analysis data
  - MR Young: no flow rates or O_2 values before last control; missing some coal analysis data
  - Reid Gardner: test report unacceptable
  - Paradise: no specific coal flow rates, uncertainties about flow rates through the various scrubber modules, multiple outlet flow data
  - Presque Isle 1: tested stack only
  - Duck Creek: tested last control inlet only

Data quality

- Extensive quality assurance effort
- Review of individual pieces of data
- Statistical examination of aggregate data and results

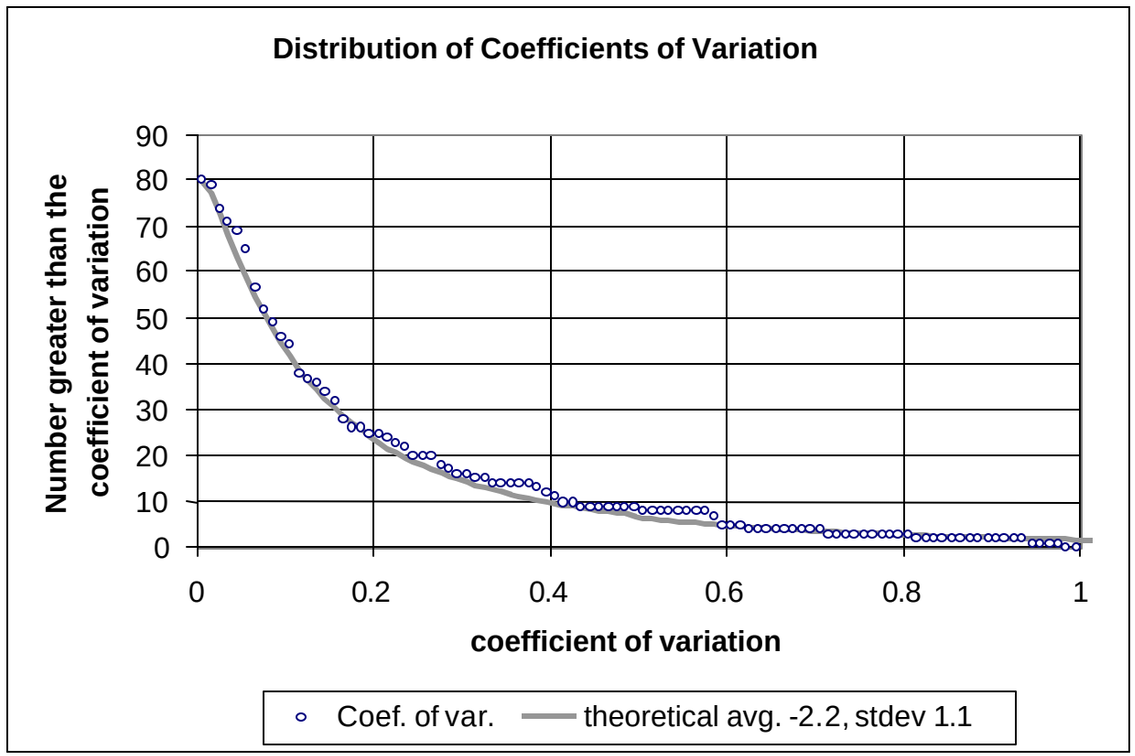
Problems with rejecting runs with differences in reported values

- Only three data points in a test run
- Many sources of variability
  - Process conditions change
  - Fuel mix may be different in the runs
  - Uncertainty in measurement
- We expect that some sets will produce more variable results than other sets

Methods to identify candidates for exclusion from the test data

- Test report indicated invalid data
- Further review identified invalid data
- Statistical analysis for potential outliers
  - Unusually large coefficient of variation
    - CV is the ratio of the standard deviation to the average value
    - CV values expected to be distributed; some will be small and some will be larger
  - Does a run measurement cause an unexpectedly large CV?

Correlation of test data with one theoretical lognormal distribution



The mean value of the ratio of std. deviation to the average value is 0.11

Sets of runs that have higher CV values

- Since some of the test sets are expected to have larger CV values; only unexpectedly large CV values should be used for potential data rejection

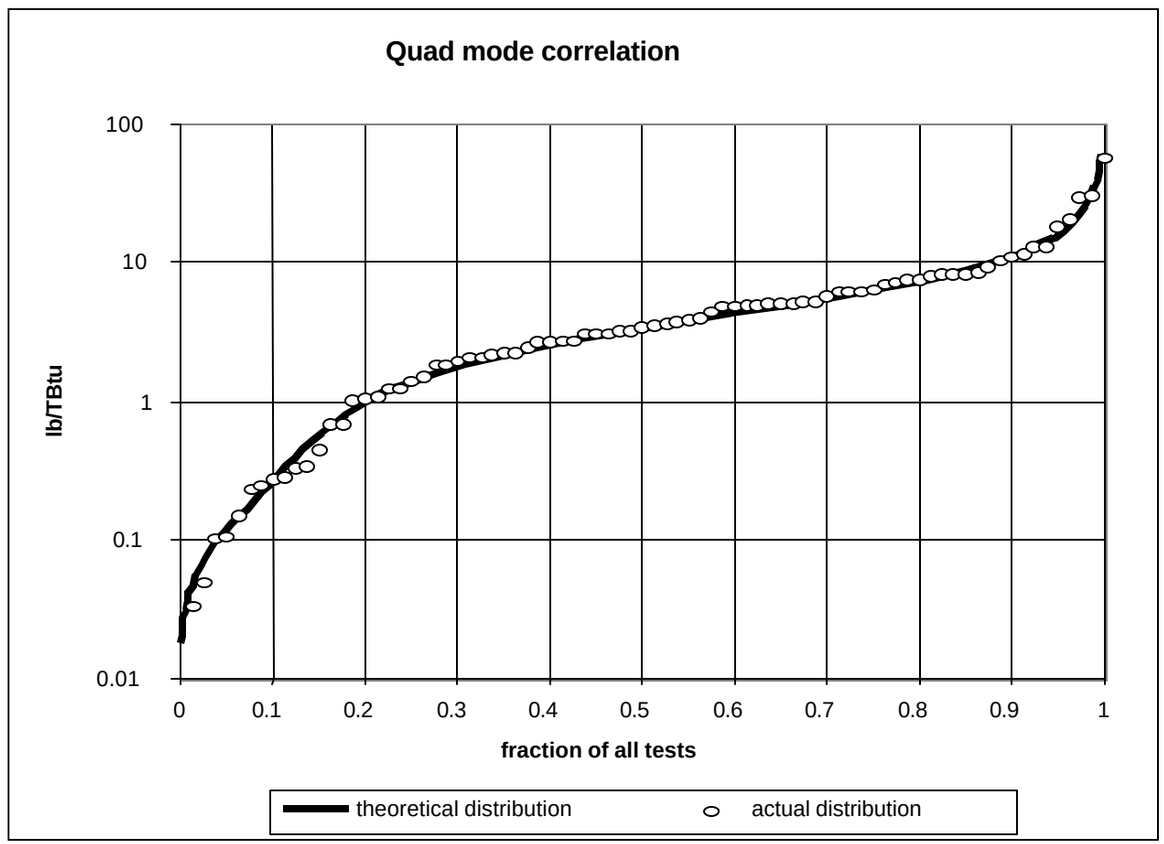
Sets of runs that have the highest CV values

- The top 5 CV values in the distribution -- the data sets with the largest differences among the 3 test values -- decrease smoothly
  - 0.98 0.94 0.81 0.71 0.61
- The 5 values are part of the CV distribution shown in the preceding curve

Review of emissions

- Estimated from composite distribution model – shown as lb/10^{12} Btu
  - Various “composites” could be used
  - Used fuel type for examples shown below
  - Each fuel gives a separate distribution
- Model based on reported measurements
  - Used test data, not estimates from national emission model

Correlation of test data with theoretical lognormal distributions



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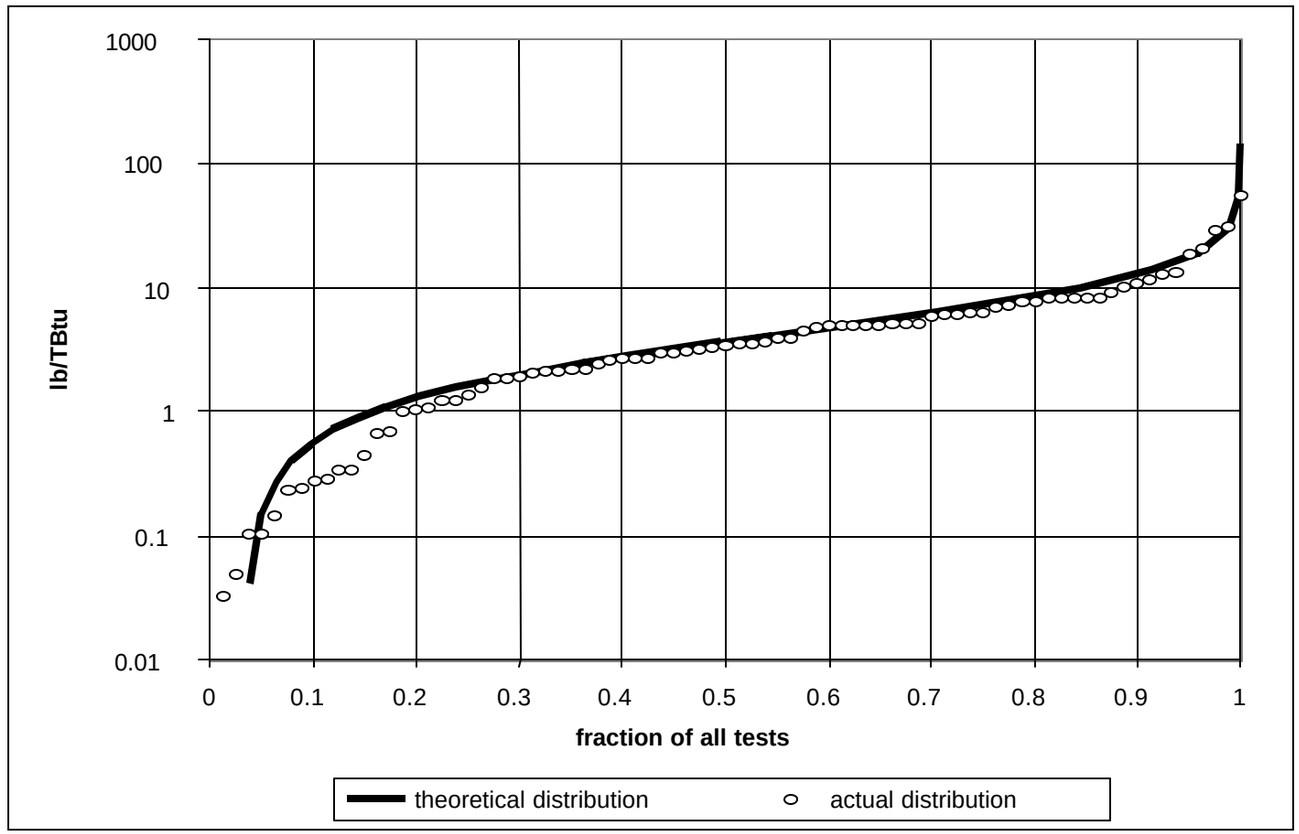

Stack test analyses -- Conclusion

- Based on conformity with the theoretical curve, we find no reason to reject any of the data sets as outliers
- Stack test analyses data are sufficient to use in the development of MACT standards